# Integrating the Supply Chain… 25 Years On


## Abstract

**Purpose** – It has been 25 years since IJPDLM published "Integrating the Supply Chain" (Stevens, 1989). The purpose of that original work was to examine the state-of-the-art in supply chain management (SCM). There have been substantial changes to the landscape within which supply chains function and changes to supply chains themselves. Given these changes it is appropriate to re-visit what is the new state-of-the art and determine whether the 1989 conceptualization requires extending. We also attempt to assess whether the evolution of SCM is associated with improved financial performance.

**Approach** – We take a conceptual approach to suggest that SCM is undergoing a transition to devolved, collaborative supply chain clusters. In addition, we consider imperatives and models for supply chain change and development. In line with the 1989 work, many of the observations in this invited paper are based on the primary author's experience. We use a selection of financial data from leading firms to assess whether SCM and changes in supply chain operating models have affected financial performance.

**Findings** – We synthesize a number of models of SCM that extend the original, highly cited work. These include goal-oriented networks and devolved, collaborative supply chain clusters. We also find the association between the evolution of SCM and financial performance over time is equivocal.

**Practical implications** – This work proposes two additional operating models that firms can implement in order to improve the efficacy of their supply chains.

**Originality** – We extend Stevens (1989) original work by synthesizing a number of additional models for SCI.



**Keywords:** Supply chain integration, supply networks, collaborative clusters, supply chain performance.

# Integrating the Supply Chain… 25 Years On

## Introduction

Some 25 years ago, one of the authors wrote an article (Stevens, 1989) that sought to explicate the state-of-the-art in supply chain management (SCM). This was at a time when SCM was still in its infancy and only starting to gain currency as an area of interest for practitioners and academics (Oliver and Webber, 1982). At the time, the organizational functions involved in managing the availability of products and satisfying customer orders operated with relative independence, often with conflicting agendas. The purpose of the original article was to facilitate understanding and encourage organizations to exploit the potential for managing their supply chains as part of a joined up (integrated) whole. The original article addressed the need to manage the supply chain at the strategic, tactical, and operational levels as well as recognizing that the scope of an organization's supply chain extended to the furthest reaches of its network of customer and supplier relationships. Stevens (1989) posited that achieving a state of "integration" required a firm to progress through a number of defined stages of development. The stages identified at the time and illustrated in the original article are shown in Figure 1.

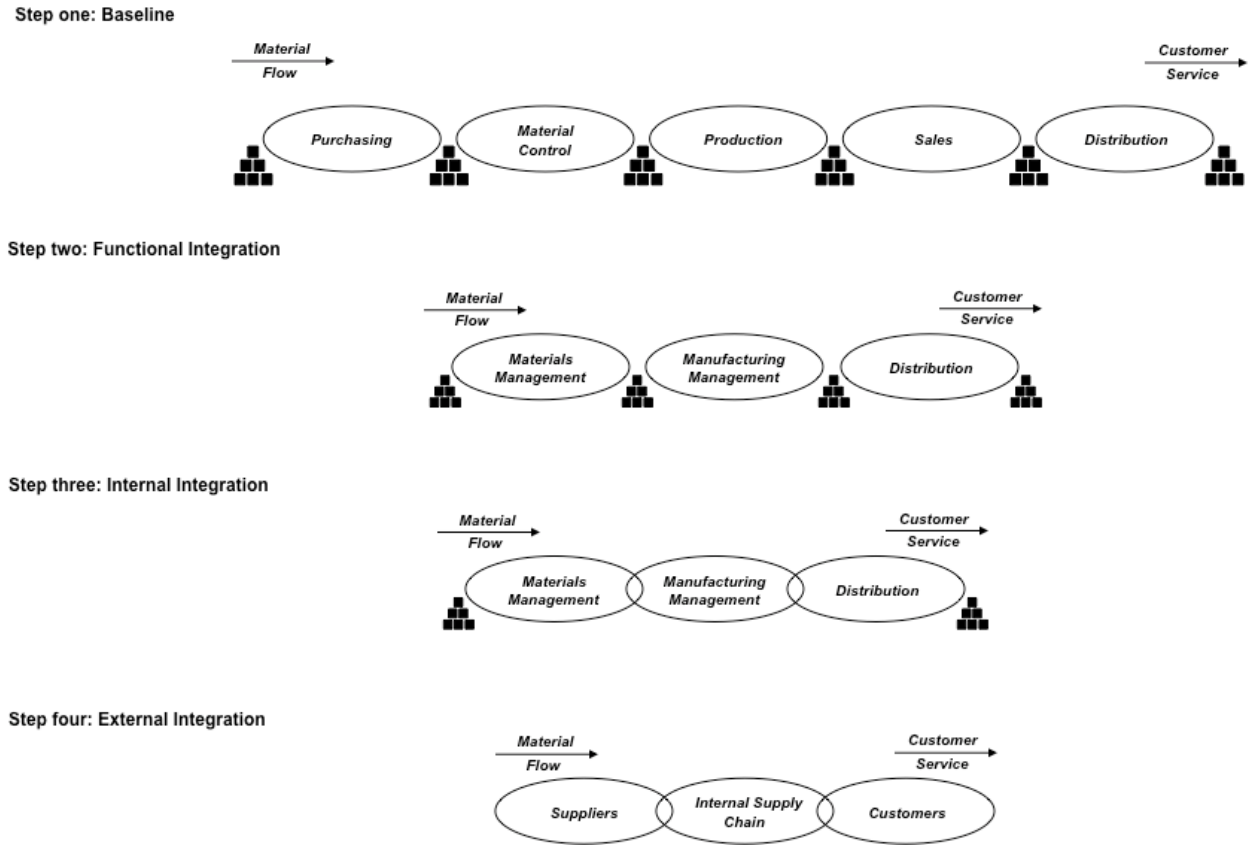



**Figure 1: Stages of Supply Chain Development (Stevens, 1989).**

As Figure 1 shows, the original article argued that SCM developed from a baseline of functional (independent) silos and the first level of integration was across functions (akin to process integration). This then moved to full internal integration involving a seamless flow through the internal supply chain, and finally to external integration embracing suppliers and customers. The primary benefits were identified as improved customer service and reduced inventory and operating costs.

Since the original article much has changed. The world today is more complex and turbulent (Christopher and Holweg, 2011). The reach of many supply chains has increased in pursuit of growth and low cost sourcing (Fredriksson and Jonsson, 2009). Technological advances have fuelled the development of new business models and ways of working (Johnson and Mena, 2008). The advent of new and maturing supply chain strategies (Christopher and Towill, 2002), tools and techniques, together with increased environmental and ethical concerns (Pagell and Wu, 2009) has increased the recognition of SCM as a driver and enabler of business performance (Johnson and

Templar, 2011). This has lead to the adoption of new supply chain practices that have elevated the role of SCM within many organizations. While much has changed, the fundamental need for "joined up" thinking and working and the need to integrate the supply chain has not. Gartner Supply Chain Group (O'Marah and Hofman, 2010), place integration as one of the elements of creating a demand-driven supply chain strategy that leads to improved firm performance (Ellinger et al., 2011; 2012). Thus, the need for SCI is still the same, if not greater than before. What has changed since the original article is the context within which supply chains operate, and the enablers of change and performance improvement. As a result the relevance of narrow, linear based supply chain models has been challenged as firms have looked more and more toward networked and collaborative supply chain strategies to deliver superior performance. The original article reported on the state-of-the-art in SCM. We retain that objective with this invited work. The aim is therefore not to revisit supply chain integration per se – as advanced in 1989 - but to explore what the future may hold and how that relates to SCI. Therefore, on the basis that 25 years-on is a good time to reflect on the changes that have taken place, the aim of this invited work is to explicate developments in SCM and SCI, and ask the questions: has SCM delivered on its promise? And, what does the future hold?

**Supply Chain Integration**

Early on in the development of SCM, firms realized the limitations of isolated improvement initiatives and misaligned functional performance agendas and began managing internal processes and flows on a much more integrated basis (Stevens, 1989). This extended the scope of integration to include upstream suppliers and downstream customers. Since the original article, there has been a growing consensus concerning the importance of integrating internal processes and flows, suppliers, and customers (e.g. Tan et al., 1998; Frohlich and Westbrook, 2001). Despite research confirming the positive benefits of supply chain integration (Prajogo and Olhager, 2012), and its importance to a firm's success (Flynn et al., 2010), ambiguity remains as to what constitutes supply chain integration (Fabbe-Costes and Jahre, 2008; Autry et al., 2014).

We posit that supply chain integration is the alignment, linkage and co-ordination of people, processes, information, knowledge, and strategies across the supply chain

between all points of contact and influence to facilitate the efficient and effective flows of material, money, information, and knowledge in response to customer needs. SCI is the foundation of SCM (Pagell, 2004). SCI is characterized by "joined up thinking, working, and decision making," underpinned by principles of flow, simplicity, and the minimization of waste. SCI may be enabled by systems and technology such as e-commerce (Gunasekaran and Ngai, 2004), MRPII, Enterprise Resource Planning (Bagchi et al., 2005) and RFID (McFarlane and Sheffi, 2003), but SCI is *not* just about technology. Integrating the supply chain refers as much to the need for strategic and operational integration within and across the business (Swink et al., 2007) as it does to relational integration with customers and suppliers (Benton and Maloni, 2005). The scope of SCI therefore includes governance, organization structure, systems, relationship management, business strategy, process design, and performance management.

**The evolution of SCM**

SCM as a discipline has evolved rapidly. The early focus of SCM began when organizations began to improve their inventory management and production planning and control. The aim of these practices was to improve production efficiencies and ensure that the capacity of capital assets and machinery was utilized efficiently. This extended upstream to include the management of transport of raw materials at a time when firms were relatively vertically integrated.

The next phase in the evolution of SCM was the systematization of materials, production and transport management. This began with materials requirement planning (MRP) focusing on inventory control (Orlicky, 1975). MRP expanded to become Manufacturing Resource Planning (MRPII) by incorporating the planning and scheduling of resources involved in manufacturing. Both MRP and MRPII were conceived in the 1960s but did not gain prominence until the 1980s (Wight, 1981). MRP and MRPII evolved to become Enterprise Resource Planning (ERP), in an attempt to gain greater visibility over the entire enterprise.

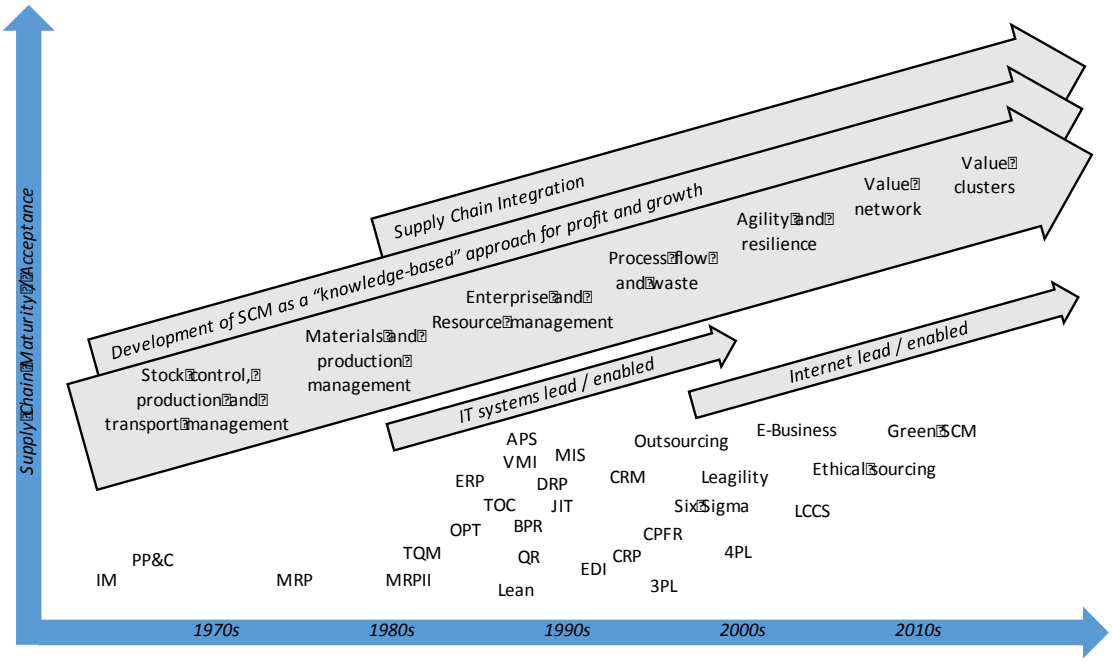
The mid to late 1980s brought intense retrospection from Western firms concerning the threat of Japanese firms that were perceived to be more competitive due to higher productivity (Hayes and Wheelwright, 1984). This period led to the implementation of 'Japanese' practices such as Total Quality Management (TQM) and Lean (Womack et al., 1990) by firms. These practices focused on reducing inventory through improving quality and flow and involving suppliers in product and process design.

The next phase in the evolution of SCM included the introduction of other process improvement practices (e.g. six sigma) that sought to provide a more concrete improvement method compared to TQM or Lean (Montgomery and Woodall, 2008). As process improvement, and the standardization of products and processes that facilitated it, took place, there was increasing awareness that end customers were requiring ever increasing levels of choice and differentiation (Christopher, 2000). This led firms to consider that they had become too lean and rigid and should be focusing on creating agile supply chains to adapt to changing demand (Aitken et al., 2002). The agile approach was blended with lean (Naylor et al., 1999) as demand could be decoupled into push and pull to create greater choice for the customer while still retaining some control (van Hoek, 2001).

The 1990s also saw a focus upon core competences within firms (Hamel and Prahalad, 1990). This led to a rise in increased outsourcing of non-core activities to lower cost economies. Political factors such as unilateral liberalization measures and the removal of formal free trade barriers have contributed to the growth of developing countries exporting to high wage economies (Gereffi, 1998), encouraging firms to source from lower cost economies. This, in turn, fuels both demand for products from developed economies and the competition to supply. This changed the topology of the supply chain as well as the magnitude, profile and direction of material, and information flows. Significant changes have also taken place around the understanding of how a firm secures a competitive position. Traditionally, superior competitive advantage was seen to be a function of how a firm organized its resources to differentiate itself from the competition (Barney, 1991) and its ability to operate at a lower cost (Porter, 2008). The prevailing tendency was to control as much of its upstream and downstream activities as possible, often leading to high levels of

vertical integration (i.e. within a firm rather than with suppliers). At the time of the original article, firms focused more on managing, in-house, core competences, i.e. those competencies or capabilities that deliver value (as perceived by the customer) and outsourcing non-core activities to specialist - often lower cost - third parties. This resulted in the advent of 3PL providers and supply chain integrators.

This all points towards an explosion in SCM thinking over the last 25 years. Figure 2 presents a timeline of SCM strategies, tools, and techniques. The dates in the figure are based upon when, in our experience, these practices were popularized, not introduced.




3PL: Third Party Logistics Provider
4PL: Fourth Party Logistics Provider
APS: Advanced Planning Systems
BPR: Business Process Re-engineering
CPFR: Continuous Planning, Forecasting, and Replenishment
CRM: Customer Relationship Management
DRP: Distribution Resource Planning
EDI: Electronic Data Interchange
ERP: Enterprise Resource Planning
IM: Inventory Management
LCCS: Low Cost Country Sourcing
MIS: Management Information Systems
MRP: Material requirements Planning
MRPII: Manufacturing Resource Planning
OPT: Optimized Production Technology
PP&C: Production Planning and Control
QR: Quick response
TOC: Theory of Constraints
TQM: Total Quality Management
VMI: Vendor Managed Inventory

**Figure 2: A Timeline of SCM Strategies, Tools, and Techniques.**

Supply chains are inherently unstable. A key role of SCM is to minimize the risks and uncertainty associated with the naturally occurring unstable state of the supply chain (Lee, 2002). Forrester's (1958) early work on supply chain dynamics highlighted the problem of the reliable "transimissivity" of information through the supply chain.

Thus, Lee et al.'s (1997) characterization of the "bullwhip" effect, demonstrates how demand and upstream load are both delayed and distorted as information progresses upstream, such that variation is amplified along the SC. This instability, coupled with the inevitable challenges of forecasting and data integrity render the supply chain unstable. Technology has been used to good effect to improve information flows (Lee et al., 2000). However, the increased remoteness of a global market and supply base, together with the need to manage an increasingly complex network has exacerbated the challenge. In addition to the issues caused by information distortion and a global supply base, the 21st century is a time when organizations are facing pressure – from consumers and other stakeholders – to have green and ethical supply chains (Srivastava, 2007). This requires organizations to become more transparent in terms of disclosing their sources of supply, which increases costs and may place pressure on moving away from the lowest-cost economies where labor rights can be poor.

**Supply Chain Strategic Imperatives**

There are two major strategies to winning business: differentiation and cost advantage (Porter, 2008). Historically, the focus for securing differentiation has been product differentiation. With life cycles now measured in months, sometimes weeks, rather than years, the opportunities to secure sustained benefit through product differentiation are diminishing. Even when a product based-strategy prevails, the window of opportunity for maximizing profit is becoming shorter and more difficult to hit such that a minor disruption to product availability has a major impact on financial return. The supply chain has, therefore, become either the driver or critical enabler for differentiation. The role of the supply chain as a major driver of cost has long been recognized. Up to 75% of a product's cost is external to the focal firm (Trent, 2004). The supply chain, therefore, also offers considerable opportunity for delivering cost advantage.

In addition to securing differentiation and cost advantage the supply chain has taken on two further strategic imperatives arising from the need to ensure resilience, responsiveness, agility, and flexibility in an increasingly turbulent and uncertain world. Typically, the supply chain accounts for 50% of a company's assets. These comprise both fixed assets such as buildings and machinery as well as current assets such as inventory. Assets, by their very nature prescribe a limited range of working

patterns and methods, thereby exposing an organization to significant changes in market structure. The nature and configuration of the asset base, the balance of fixed assets to current assets, and the profile of inventory and cash all influence the resilience of the supply chain and influence a firm's ability to mitigate risk. At an operational level, customers are becoming increasingly demanding in terms of both responsiveness and flexibility. Accordingly, the agility of the supply chain, in terms of structure, management, systems, and processes impacts directly the ability of an organization to respond to customer needs. The role of the supply chain and the focus for SCM can therefore, be summarized as to support an organization to win business competitively by addressing the strategic imperatives of differentiation, cost advantage, resilience, and dynamism (agility, flexibility, responsiveness). In the following section we discuss how these strategic imperatives, together with their drivers and enablers, influence the way in which the supply chain is configured and managed.

**Supply Chain Operating Model Dynamic**

A firm's supply chain operating model (SCOM) is a translation of the firm's supply chain strategy and need to deliver the strategic imperatives, into operational terms. The design of the model needs to consider the external economic and competitive drivers, leverage current and future likely enablers, and deliver the required level of performance. Figure 3 provides an overview of a SCOM and its related dimensions.

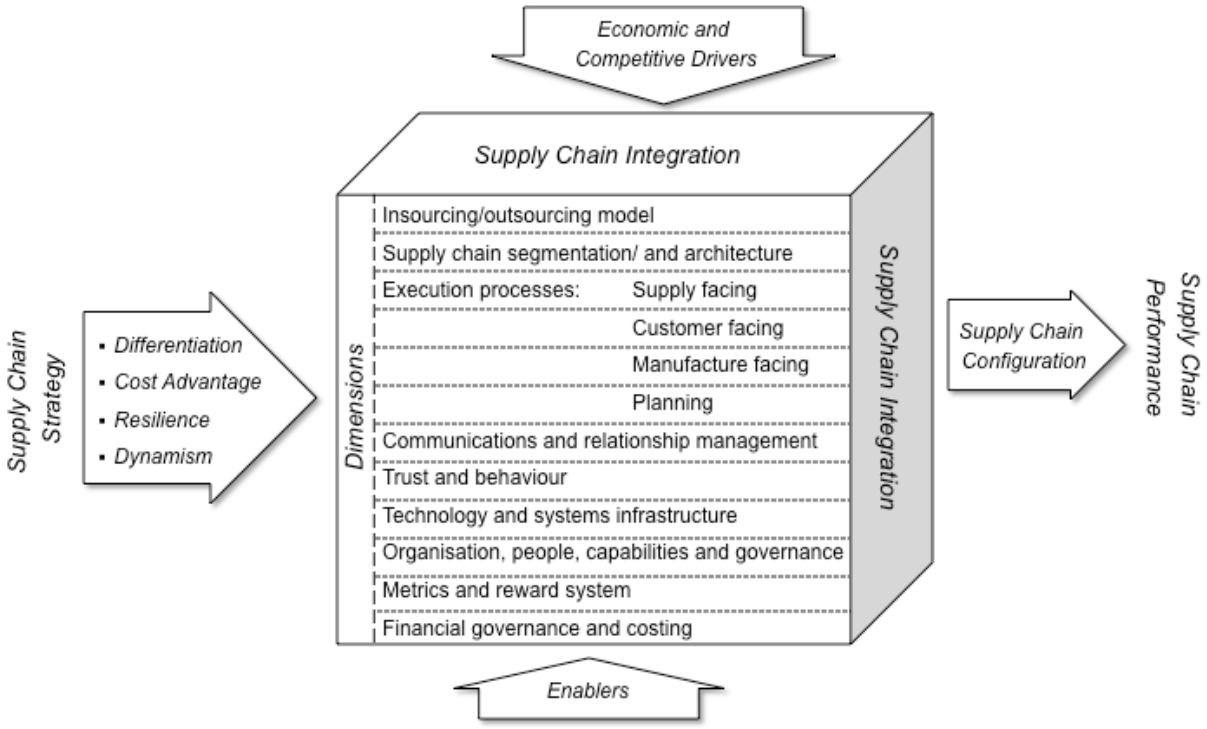



**Figure 3: Dimensions of a Supply Chain Operating Model.**

The operating model comprises a series of dimensions; each dimension representing a distinct aspect of a firm's supply chain. The decisions a firm makes on the design of each dimension, the overall configuration, and how the dimensions interact to form an integrated supply chain determines the performance of a firm's supply chain. Firms operating in the same sector may have similar operating frameworks - due to market, technological, and mimetic (i.e. the promulgation of 'best' practice) influences. The detailed design and configuration will be unique to each firm, reflecting localized decisions on how best to secure a competitive advantage from its supply chain. A firm's SCOM is not fixed. It needs to develop in response to internal and external changes if a firm is to exploit the potential from new opportunities and maintain competitive performance.

### Supply Chain Change Model

Given the pressure to improve and the need for firms to continually challenge the performance and capabilities of their supply chain operating model, the question is: how do firms develop their supply chains to secure and maintain value and competitive advantage? How do they adapt to changing economic drivers, take advantage of new technologies and enablers and respond to the increasing need to

deliver a differentiated offering, secure cost advantage, while ensuring a resilient and dynamic supply chain able to combat the risk of disruption and major disturbance? What change model operates? A review of supply chain development over the last 25 years suggests a model comprising periods of **fundamental change** followed by an on-going focus on **continuous improvement** based on a combination of *process and capability improvement*, together with localized *structural adjustments* to the scope and/or topology of the supply base. Figure 4 illustrates the SCOM "dynamics of change".

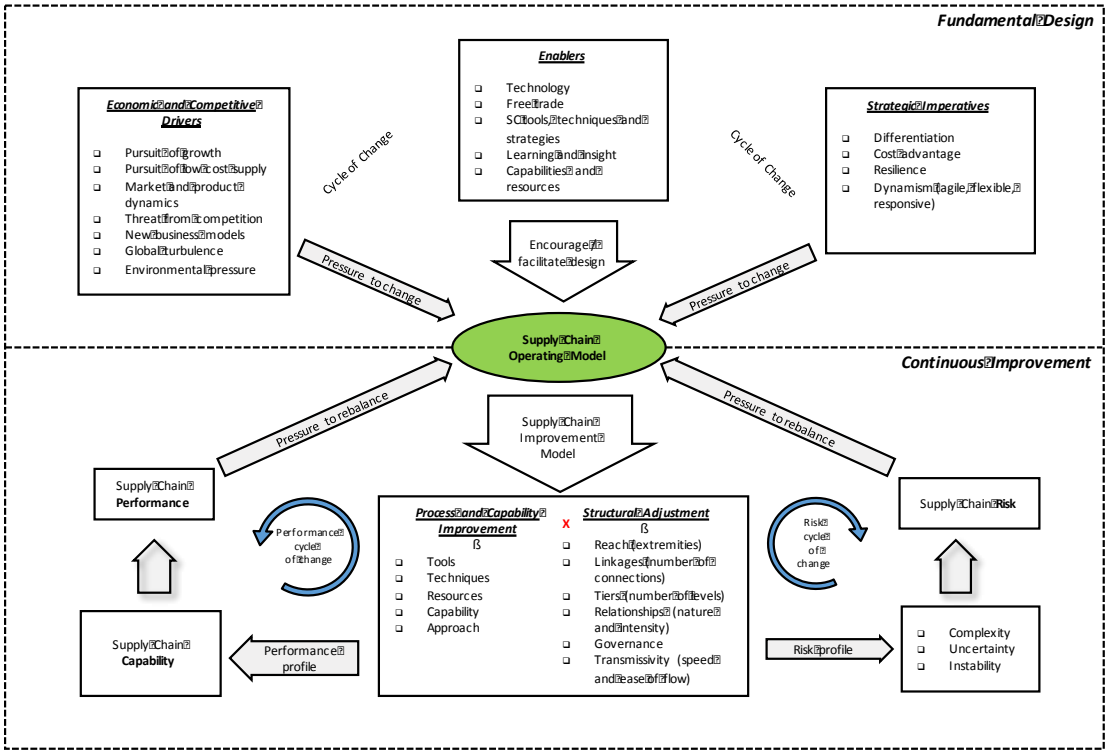



**Figure 4: Supply Chain Operating Model Dynamics of Change.**

What is it that drives the need for fundamental change? Since the early 90s Business Process Re-engineering (Hammer, 1990), Lean (Womack et al., 1990) and many other improvement tools and techniques have provided valuable contributions to improving supply chain performance. Local, incremental process improvement can deliver benefits. However, the very nature of the benefit emanating from on-going reliance upon small incremental process changes is unlikely to have a corresponding impact on the performance of the supply chain as a whole. Inevitably, continuous process improvement will be confronted by the "law of diminishing returns" as significant opportunities become less and competitors copy early adopters.

Process improvement is underpinned by *process analysis*, that is breaking the process down into its constituent parts by mapping product and information flows, in an attempt to improve understanding and expose opportunities to improve (Hines and Rich, 1997). Such improvement is predicated on the supply chain as a repeatable process but supply chains are inherently more complex. Supply chain performance is based on the interaction of processes from the perspective of a "system", thus performance is through synthesis. Developing a supply chain's performance requires focus on the interaction of processes not the optimization of isolated processes. Significant change to supply chain performance cannot be delivered by focusing exclusively on improving isolated processes; improvement will only come through improved interaction of processes.

Globalization of supply chains has encouraged firms to pursue low cost sourcing by increasing the reach of the supply base, "flipping" suppliers as cheaper alternatives emerge, chasing increased control by seeking to manage multiple tiers of supply and splitting purchasing spend across multiple sources in an attempt to stimulate competition. Delivering short-term, localized reduction in purchase cost has significant consequences and implications leading to increased complexity, uncertainty and instability. As shown in Figure 5, the compound effect of the relentless pursuit of low-cost sourcing is an exponential increase in risk.

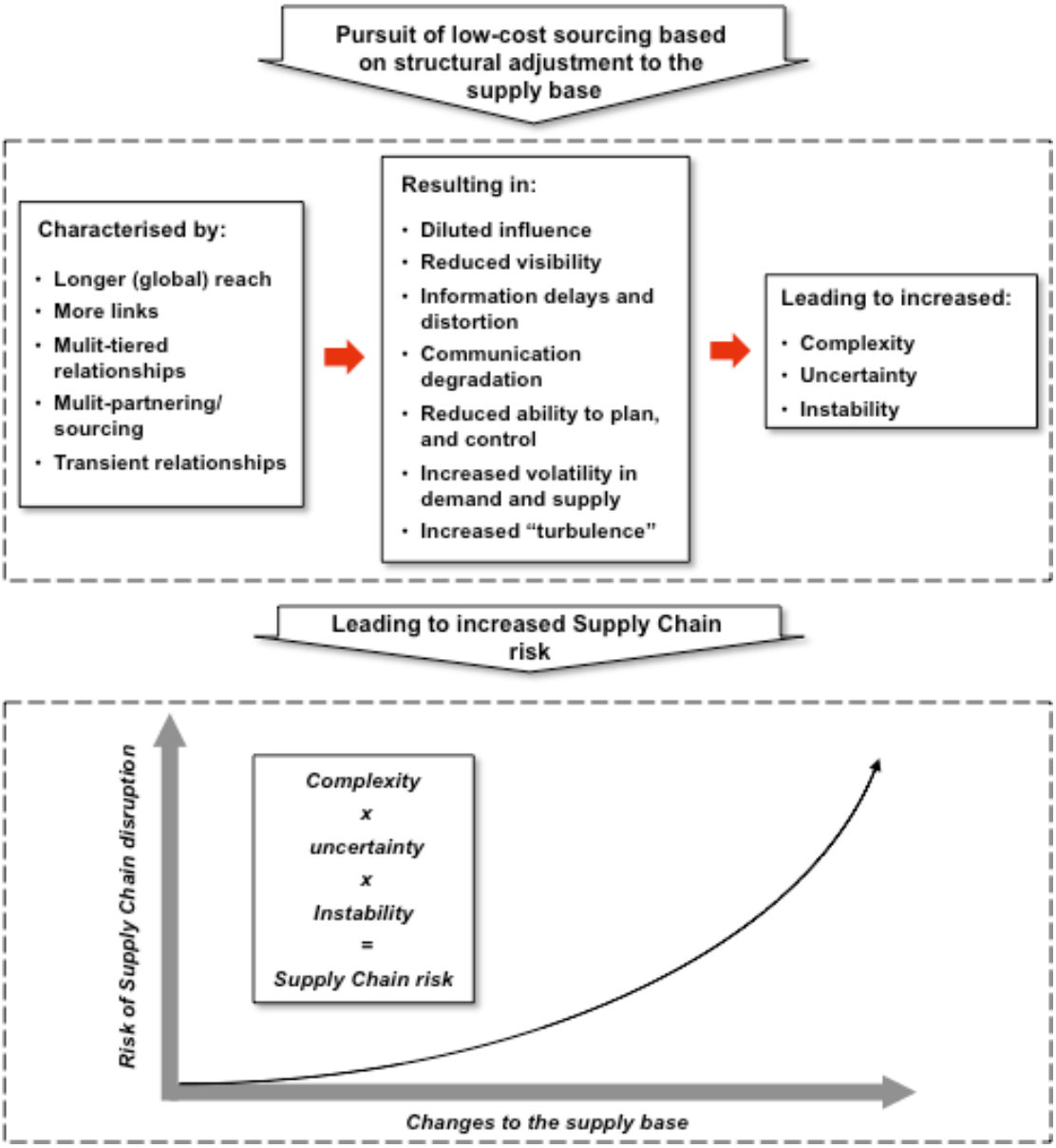



**Figure 5: The Compound Effect of the Relentless Pursuit of Low-cost Sourcing**

Supply chain leaders relying on a strategy of continuous process and capability improvement, together with frequent structural adjustment to the supply base to sustain their leadership position inevitably find that diminishing returns, coupled with increased risk, erodes their leadership position as the performance gap over the competition reduces and the "followers" catch up. At this point a firm can be said to have hit the "Performance Frontier," (cf. Schmenner and Swink, 1998) whereby the cost and risk of further incremental change is more likely to have a destabilizing

effect and a negative impact on relative or absolute performance. Securing advantage at this point requires fundamental change to the operating model, i.e. a paradigm shift.

Firms should seek to maintain a state of equilibrium until such time that the diminishing return from striving to continually improve combined with an on-going pursuit for leveraging more out of the supply base destabilizes the supply chain rendering the supply chain operating model unstable. Thereafter, the way forward is to seek a step change in structure through fundamental change in order to secure a stable basis for continued growth. During the period of fundamental change there is likely to be a drop in performance while the new structures and ways of working are embedded and optimized.

Supply Chain development can be said to follow a path of "Punctuated Equilibrium," (cf. Gersick, 1991). This comprises an alternation between long periods of relative structural stability, followed by brief periods of upheaval as a firm seeks competitive advantage through a process of fundamental structural change (a "paradigm shift"). During periods of stability the conceptual framework, basic organization and operational principles of the operating model are stable and can be said to be in a state of equilibrium. The underlying activities are subject to incremental adjustments through a process of continuous improvement able to respond to changes in the external environment, competitive pressures, and operational capabilities. The state of equilibrium continues as long as the underlying changes deliver a positive contribution. Once the performance frontier has been reached, a firm needs to seek fundamental structural change to secure a competitive advantage and establish a platform for further continuous improvement.

**SCM Development Model**

The principle of integrating the supply chain as a cornerstone of supply chain management was introduced in the early 80s. Since then the business context has changed and the structure of supply chain operating models has developed accordingly. The limitations of supply chain models based on "linear" physical flows have been exposed (e.g. Choi and Wu, 2009; Bastl et al., 2012) and new phases of networked supply chains have developed. Figure 6 suggests the need to add two

further stages to the development model proposed by Stevens in 1989. The additional stages are predicated on the need for integration but reflect the changes in context and capabilities.

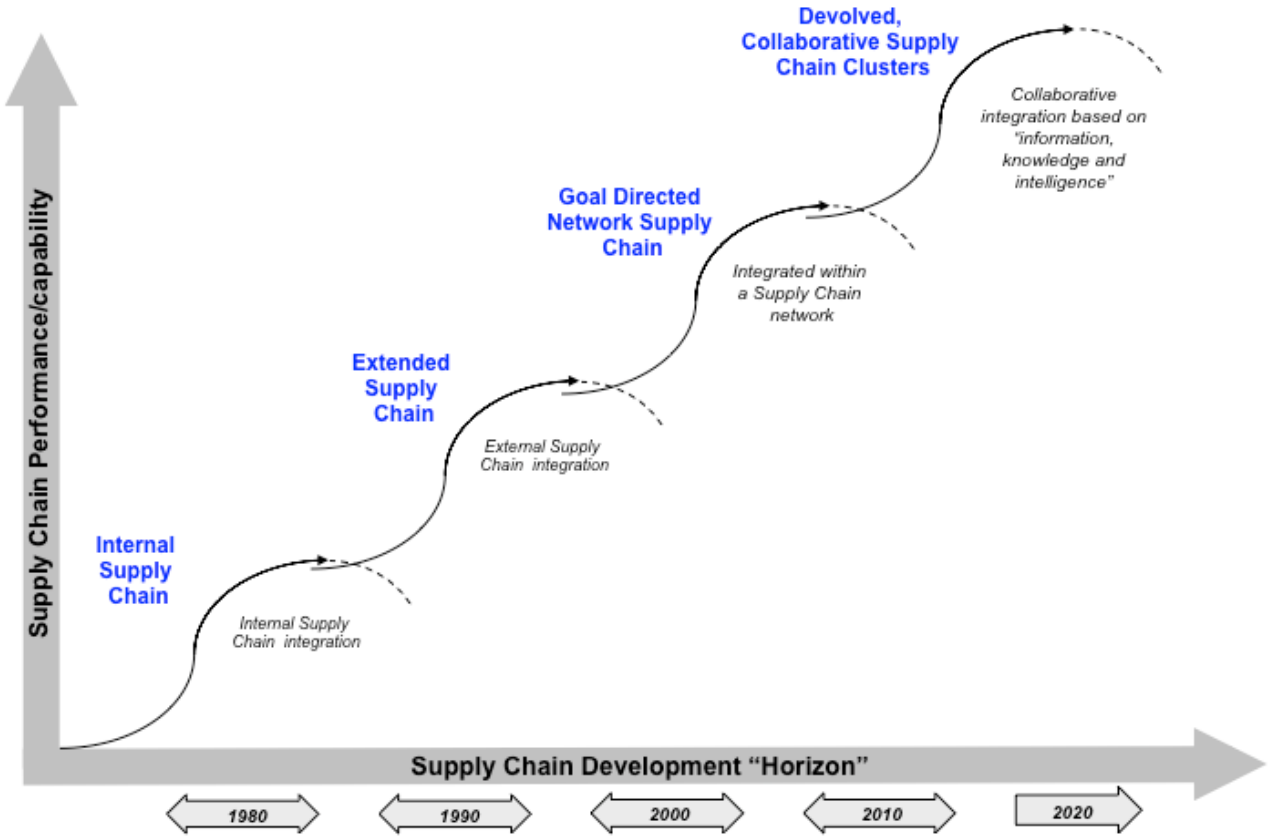



**Figure 6: Phases in Supply Chain Management Development.**

The transition between phases represents the point at which the extant phase begins to show diminishing returns for the focal firm. Internal supply chain integration transitioned to external supply chain integration as there was a limited amount of performance improvement that could be achieved without involving suppliers and customers. External supply chain integration transitioned to goal directed network supply chains as firms understood that supply chains were non-linear networks and that there would be benefit for non-strategic (or non-integrated) suppliers to have visibility of demand. We suggest that – at the time of writing – we are undergoing a transition to devolved, collaborative supply chain clusters. We suggest that this

transition is occurring due to the increased coordination costs that are being borne by focal firms who are attempting to coordinate large networks. By effectively outsourcing this coordination to lead suppliers, there is devolvement of the collaboration into clusters. For example, Zara has popularized the localized, collaborative cluster model (cf. Ghemawat, 2005) although this model currently has a tendency to be implemented in industries with relatively simple products or services, or around a single industry (e.g. Silicon Valley). The early phases of development, internal and external integration, were addressed in the original article, and are briefly revisited below.

*Internal Integration*

Internal integration represents the evolution of a firm's SCOM from the functional separation of the 1970s to a model based on the 'closed loop' business and resource planning of the late 1980s. Functional separation was characterized by individual functions having their own agendas with limited interaction resulting in high unit costs, high levels of inventory, and poor customer service. The objective for most supply chains was inventory management based on aggregate inventory, stock replenishment using re-order point, and economic order point techniques with limited recognition of the needs of production plans or customer demand. At this time the focus for SCM was to balance supply and demand within the constraints of the business plan. The scope of the supply chain model included commercial, production, technical, purchasing, finance, and materials management and was underpinned by joined up thinking, working and decision-making.

*External Integration*

External integration involves extending the scope of the integrated supply chain to include supplier integration, distribution integration, and customer integration.

Supplier integration focuses on improving the performance of the supply chain between a firm and its supply base. It involves sharing information between both parties enabling a firm to influence costs, quantities and timing of deliveries and production in order to streamline the product flow and to move to a collaborative relationship. Supplier integration often involves a partnership model, with deeper, more long-term relationships with fewer vendors that, in turn, tend to have

relationships with fewer customers. This helps build communication channels and trust, which facilitates more extensive knowledge sharing. Supplier integration involves suppliers taking increased responsibility for aspects of availability and product development. It involves increased interactions between businesses and functions to increase productivity and availability and reduce the risk of non-compliance.

Distribution integration focuses on detailed resource and flow management through the outbound logistics network in order to reduce logistics and distribution costs and provide increased demand visibility. The focus moves away from the efficient management of transport to planning and controlling the efficient forward and reverse flows and storage of goods and related information as part of an integrated supply chain.

Customer integration involves leveraging the supply chain's capabilities as part of the customer proposition and a firm collaborating with customers to add value to both parties. The cornerstones of supply chain customer collaboration are cultural and process integration, whereby both parties contribute their unique insights and capabilities to develop a mutually agreed forecast of demand that meets the needs of the customer, within the constraints of the firm. Customer integration is well operationalized by Collaborative Planning, Forecasting, and Replenishment (CPFR). The benefits of CPFR are well documented, typically in the order of a 10-40% inventory reduction in supply chains (Lapide, 2010). Despite the benefits of internal and external integration, the wider business landscape has changed resulting in the need to conceptualize the new SCOMs of goal directed networked supply chains and devolved, collaborative supply chain clusters. We turn to these next.

*Goal Directed Networked Supply Chain*

Early supply chain operating models focused on the linear relationships and flows between customers and suppliers. While the linear perspective may have reflected simplified material flows and aided firms to develop techniques for planning and controlling a physical supply chain, the approach quickly diverged from evolving reality. The dramatic increase in access to information in the late 1990s, the advent of internet communication and the pursuit of global trading and low cost sourcing,

caused leading firms to revise their perception and management of supply chains from physical flows to information flows. Recognizing the supply chain as a network of relationships (e.g. Harland, 1996) not a sequence (or chain) of transactions enabled leading firms to gain improved performance, operational efficiencies, and ultimately sustainable competitiveness (e.g. Choi and Hong, 2002). Figure 7 presents an illustration of a Networked Supply Chain.

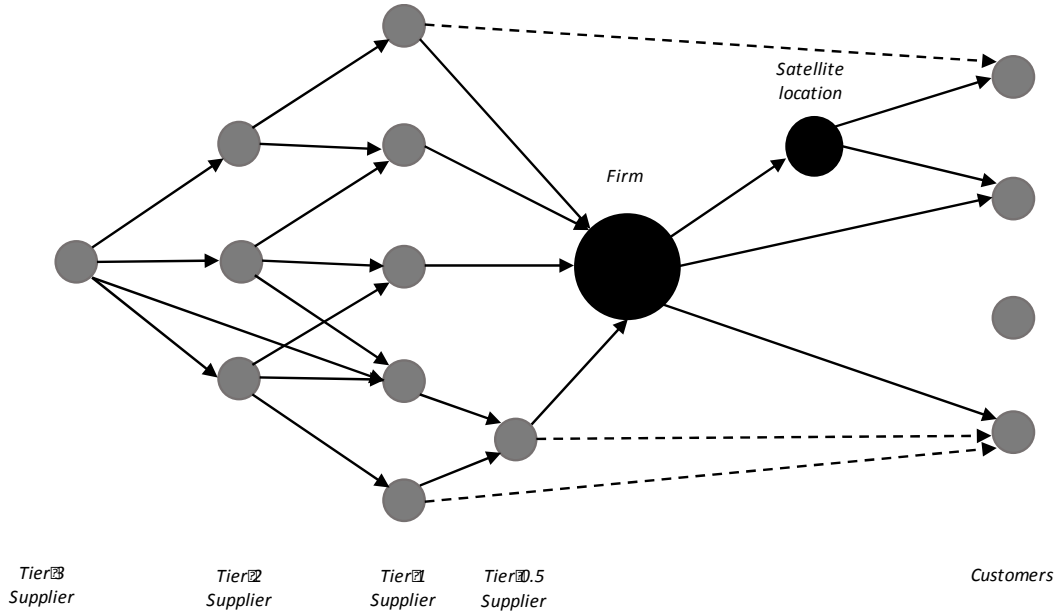



**Figure 7: Networked Supply Chain**

This model is based on recognizing that the supply chain is a non-linear network with connections between firms. It acknowledges that there can be relationships between suppliers and customers and having visibility of the network can uncover potential risks (cf. Choi and Hong, 2002). The culture and organization of most early adopters of the network perspective was invariably based on a "traditional" command and control style of management, underpinned by a centrally based structure. This manifested itself in a desire to control the sourcing of the bill of material by engaging in directed sourcing. This is where the firm established relationships with second and third tier suppliers and directed the top-tier supplier to source material from them. This SCOM is referred to as a goal directed networked supply chain as supplier relationships and sourcing strategies are aligned with the firm's overall cost, quality, and service goals.

One of the key challenges of managing within networks is the presence of indirect relationships (cf. Choi and Wu, 2009a). From Figure 7, an example of an indirect relationship is the one between the supplier and the customer represented as a dashed line. For example, Amazon often uses a 3PL to fulfill customer orders. This creates a direct relationship between the 3PL and the customer. The customer's satisfaction with Amazon thus becomes reliant upon the performance of the 3PL (cf. Choi and Wu, 2009b). This type of structural arrangement is referred to as a triad with all firms within the triad being interdependent. However, the critical issue within the network is the management by the focal firm (e.g. Amazon) of the indirect relationship (e.g. between 3PL and customer). With a networked supply chain there is a significant burden in coordinating all of the direct and indirect relationships in order to meet the goal of the focal firm. This has led firms to create SCOMs that devolve coordination responsibilities to lead suppliers (occasionally known as 'Tier 0.5') who then coordinate collaborative clusters.

*Devolved, Collaborative, Supply Chain Clusters*

The next step in the evolution of SCOMs is the transition to devolved, collaborative supply chain clusters. Choi and Hong (2002), examined the traits of supply networks in terms of formalization, centralization, and complexity. Formalization is closely associated with standardization through rules and procedures as well as norms and values. Centralization addresses the degree to which authority or power of decision-making is concentrated or dispersed across the network. Complexity refers to the structural differentiation or variety that exists in the network. The three dimensions form a useful basis for highlighting the limitations of Goal Directed Networked Supply Chains and the emergence of Devolved, Collaborative, Supply Chain Clusters.

The centralized organization structure and underlying need for formality to support the central control of a Goal Directed Networked Supply Chain gave rise to a rigid, inflexible structure unable to cope with the turbulent environment of the last ten years. Similarly, the increase in reach, coupled with attempts to control the bill of materials significantly increased the number of nodes and connections in the network in addition to heavily impacting transaction costs within a firm. The work on the empirical relationship between system size, connectance, and stability carried out by Disney et al. (1997) identified two important phenomena relevant to supply chain

operating model design as: 1) as the number of nodes increases the probability of a stable operation decreases dramatically, and; 2) as system connectance increases the network swiftly crosses the "switching" line and becomes unstable.

Thus, the implications for supply chain performance are clear. The complexity inherent in a large supply chain network is likely to render it unstable, resulting in a major deterioration in performance. The complexity of the network also leads to an increase in coordination cost. Developing a SCOM to equip a firm to manage a global supply network needs to address the issue of how to accommodate and coordinate the needs and activities of multiple participants without undue complexity, cost or formality. It should provide a level of governance sufficient to ensure that participants engage in collective and mutually supportive actions, such that any conflict can be addressed and the objectives of the firm's supply chain met. As presented in Figure 8, we posit that that the future global integrated supply chain model will be Devolved, Collaborative, Supply Chain Clusters.

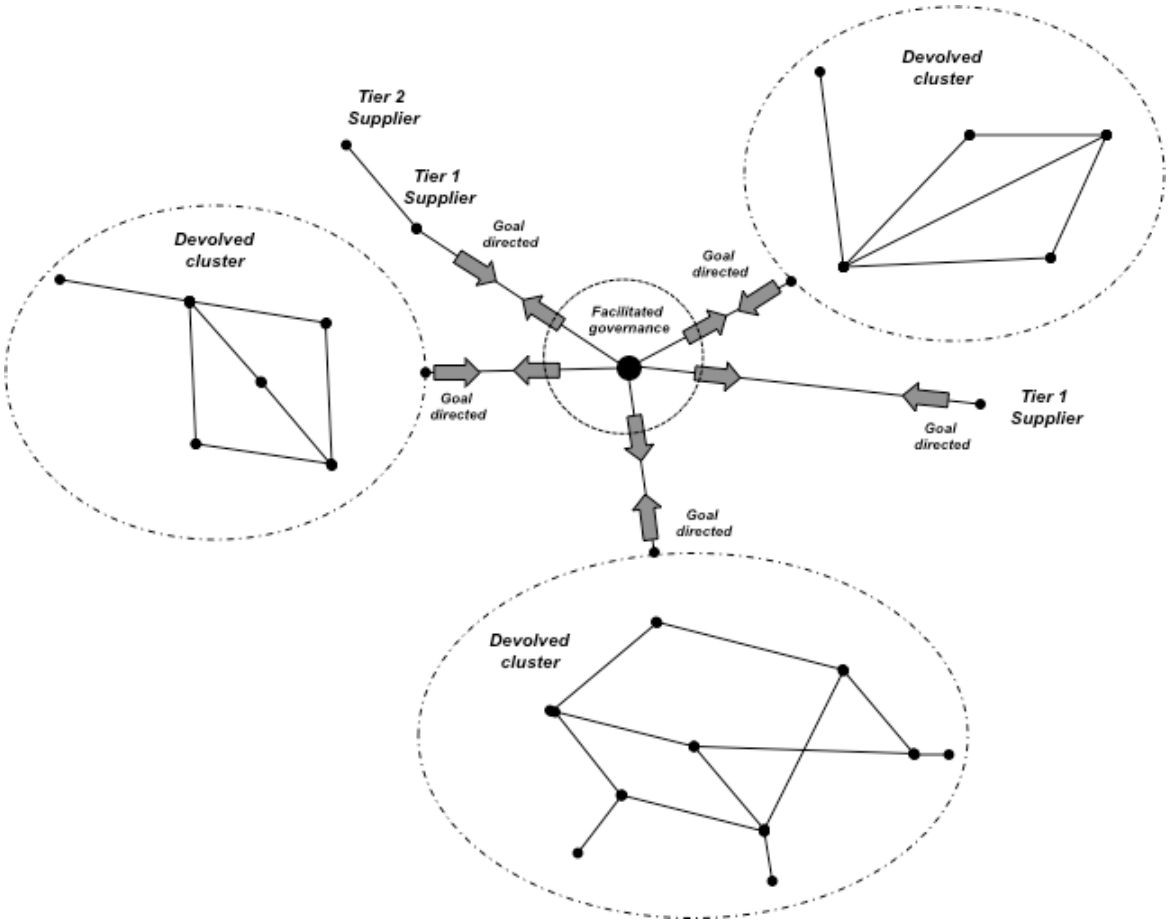



**Figure 8: Devolved, Collaborative Supply Chain Clusters.**

This model is based on a series of self-governing clusters, each cluster comprising a network of suppliers and/or sub-contractors associated by type, product structure, or flow. All non-core activities are outsourced by the firm (or lead organization) across a range of clusters. Collaboration within and across each cluster is based on goal consensus, whereby the goals for each cluster are aligned and managed in accordance with the goals of the firm. Operational co-ordination, planning, and governance across clusters are facilitated by the lead organization through an integrated collaboration and operations management and planning protocol supported by clear lines of responsibility and accountability and a visible performance management system. This operates in a network-wide culture where economy of scale and efficiency are subordinate to service, resilience, and effectiveness.

Research into clusters is by no means a new phenomenon (cf. Porter, 1998; Sheffi, 2012). However, much of the previous work has focused on the innovativeness of the cluster or the specialization of competences into an industrial district (e.g. Pinch, et al., 2003), or has focused upon knowledge management within the cluster (e.g. Miles and Snow, 2007). With devolved, collaborative supply chain clusters the focus moves from the *cluster* to *clusters*, and to the governance of the clusters. This is challenging as the management of the clusters is reliant upon 'architectural knowledge' (*cf.* Tallman et al., 2004) which is external to the firms within the cluster. Architectural knowledge in the context of the devolved, collaborative supply chain clusters is related to understanding the network as a system and the structures and routines required to effectively coordinate it (*cf.* McGaughey, 2002).

Within devolved, collaborative supply chain clusters, SCI moves away from being a monolithic approach to one that enables the 'modular' connecting of the focal firm to the different clusters. This will be facilitated via shared language and thinking. For example, BS11000 is a standard that aims to provide a common language to enable collaboration (Hawkins, 2013). We argue that a common language is required to 'lubricate' the flow of information, knowledge, and insight between the devolved clusters and the lead organization.

Table 1 contrasts the four different operating models depicted in Figure 6. The table summarizes the key characteristics of each dimension against the four primary stages of Supply Chain development. The change from one operating model to another will, we suggest, occur at each 'punctuation' (*cf.* Gersick, 1991). Table 1 is indicative (or descriptive) rather than definitive (or prescriptive) illustrating changes to process, structure, relationships, and emphasis.

**Table 1: Comparison of the four operating models.**

| ***Dimension*** | ***Supply Chain Operating Model*** | | | |
|---|---|---|---|---|
| | ***Internal*** | ***External*** | ***SC Network*** | ***Cluster*** |
| **Insourcing/ outsourcing model** | Tactical subcontracting, limited outsourcing | Tactical subcontracting. Advent of outsourced logistics (3PLs) | Use of 4PLs. Off-shoring and low cost sourcing prevalent | Focus on retaining core in-house. Collaborative partnerships based on "total cost of supply" |
| **Supply chain segmentation/ and architecture** | Internal integration | External integration | Networked | Multiple Clusters |
| **Execution processes: Supply facing** | Transactional, adversarial | Flow, joined up processes | Combination of transactional/short term and off-shoring/low-cost partnerships | Focused relationships based on agreed goals |
| **Execution processes: Customer facing** | Transactional | Flow, joined up processes | Strategic/ longer term | Strategic/ longer term |
| **Execution processes: Manufacture facing** | In-house, vertically integrated | In-house, vertically integrated | Dispersed | In-house core, strategic partnerships non-core |
| **Execution processes: Planning** | Material and resource focus | Sales and Operations based | Linked to business planning; multi-tiered | Strategic high level |
| **Communications and relationship management** | Transactional, adversarial | Information based | Information and knowledge based | Information, knowledge and insight based |
| **Trust and behavior** | Limited, adversarial | Contract based, co-operative | Contract based, collaborative | Relationship based, collaborative |
| **Technology and systems infrastructure** | Order taking and materials and production planning and control. Centralized | Enterprise focus. Centralized, supported by "professional PC-based systems" | Network focus. Centralized/common core, supported by internet enabled trading and product development with "professional PC based systems." | Cluster, fit for purpose based. Highly internet enabled. |
| **Organization, people, capabilities and governance** | Hierarchical and centralized. | Hierarchical and centralized with focused customer and supplier management | Hierarchical and centralized with focused customer, supplier and or regional management | Flatter and de-centralized. Based on points of governance, supported by focused and aligned cluster performance |
| **Metrics and reward system** | Functional and retrospective. Focus on "cost-out" | Organizational, flow based | Hierarchical and cascading | High level, cluster performance based |
| **Financial governance and costing** | Standard costing | Activity Based Costing | Lifecycle costing | Throughput accounting |

The evolution of the SCOMs has been influenced by a number of factors. The growing realization that SCM is critical to a firm's success has made it more strategic

with a long-term focus. Firms have also focused more on what is core to their success and have outsourced that which is not. This has been balanced by the need to understand and coordinate supply chain networks to increase effectiveness and reduce risks. The coordination costs of this are potentially high and firms have built collaborative relationships with lead suppliers who coordinate specialized clusters whose capability is leveraged. Overall, this means that SCOMs have moved from an attempt to control towards a realization that they can, at best, coordinate the network. Planning now takes place at a strategic level and considers not just materials and capacity, but capability and the long-term goals of the firm. This is facilitated by better use of information, knowledge, and insight so pro-active decisions can be made. Another enabler are metrics and accounting systems that enable collaborative behavior and focus on the efficacy of the network.

Now that we have discussed changes to SCM and SCI since the original article we turn to examining whether SCM has delivered on its promise.

**Has SCM Delivered on its Promise**

Horvath, (2001) suggested that the most considerable benefits to a business with advanced SCM would be radically improved customer responsiveness, customer service and satisfaction, increased flexibility for changing market conditions, improved customer retention, and more effective marketing. Ellram and Liu (2002, p.30) suggested: "Supply chain management can significantly affect a company's financial performance – both positively and negatively." Sales growth, operating profit margin, working capital investment, and fixed capital investment impact shareholder value, all of these are within the influence of SCM (Lambert and Burduroglu, 2000). However, it is empirically difficult to link the evolution of SCM with financial performance.

In an attempt to determine the impact of SCM, and consistent with Ellinger et al.'s assessments of top SC performers financial performance (2011; 2012), we examine the performance over time of a number of companies, across multiple sectors, against three indicators of SC performance. These indicators are Return on Net Assets (RONA), inventory turns, and the unified proxy for SC performance developed by

Johnson and Templar (2011). We assess these indicators against ten companies from a range of sectors, between the years 1997-2014, selected from the Fortune Global 500 Top 25 and a population of companies that appear in the Gartner Supply Chain Top 25 between 2010-15. The selection is intended to ensure representation of companies at the forefront of exploiting leading edge supply chain development to assess whether acknowledged leaders in SCM practice have positively influenced recognized financial indicators over an extended time frame. The results are shown in Table 2.

**Table 2: RONA, Inventory Turns and Supply Chain Proxy Values for 10 Selected Companies 1997-2014.**

| Company | RONA | Max / Min / Avg (log. Trend) | Inv Turns | Max / Min / Avg (log. Trend) | SC proxy | Max / Min / Avg (log. Trend) |
|---|---|---|---|---|---|---|
| Apple | | 28.54 / -21.78 / 10.24 (+) | | 219.51 / 7.28 / 81.43 (+) | | 0.58 / -0.54 / 0.25 (+) |
| Ford | | 11.72 / -5.81 / 1.60 (-) | | 22.34 / 14.23 / 17.97 (-) | | 0.26 / -0.48 / 0.00 (+) |
| Home Depot | | 15.19 / 5.29 / 11.45 (-) | | 5.91 / 4.18 / 5.09 (-) | | 0.33 / 0.13 / 0.23 (-) |
| HP | | 10.67 / -10.62 / 5.55 (-) | | 15.26 / 4.11 / 9.30 (+) | | 0.33 / -0.12 / 0.12 (-) |
| IBM | | 14.09 / 3.83 / 9.46 (+) | | 22.51 / 7.45 / 16.59 (+) | | 0.32 / 0.09 / 0.20 (+) |
| Kimberly Clark | | 13.62 / 8.11 / 10.22 (-) | | 6.33 / 5.49 / 6.02 (-) | | 0.29 / 0.12 / 0.21 (-) |
| P and G | | 12.92 / 7.56 / 10.00 (-) | | 6.61 / 5.06 / 5.97 (-) | | 0.11 / -0.23 / -0.01 (+) |
| Samsung | | 15.88 / -2.26 / 9.02 (+) | | 10.28 / 4.10 / 8.01 (+) | | 0.61 / -0.04 / 0.22 (+) |
| Toyota | | 5.43 / -1.42 / 3.22 (-) | | 18.26 / 11.17 / 12.34 (-) | | 0.16 / -0.05 / 0.07 (-) |
| Walmart | | 9.33 / 7.79 / 8.58 (-) | | 9.12 / 5.77 / 7.86 (+) | | 0.33 / 0.13 / 0.25 (-) |

The analysis suggests that the overall impact of improving SCM practices has been equivocal (thirteen positives to seventeen negatives). Inventory performance has improved for half the firms. The supply chain indicator suggests similar levels of improvement. Overall RONA shows an adverse impact (three positives to seven negatives). The authors acknowledge the limitations of the analysis and the impact of recent changes to the global economy, but suggest that while it points to some firms realizing benefit from improved SCM, the majority have failed to leverage the full potential of their supply chains. We suggest that this failure is that firms are not recognizing that the SCOMs that have worked so well, for so long, may no longer be appropriate in today's volatile, uncertain, complex, and ambiguous world.

The challenge for SC managers is therefore how do they change their SCOMs to adapt to changes in the business environment, economy, technology and customer demand. This requires the supply chain community (academics, advisors and practitioners) to work collaboratively to operationalize the thinking and deliver measurable, sustainable benefit on a consistent basis.

**What Does the Future Hold?**

The current challenges presented by a global economy, accelerating rates of change and the emergence of new and innovative competitors will undoubtedly persist. The role of the SCM as an enabler of business success will not go away. It is more likely that the pressure on the supply chain will increase. SCM's response needs to first, find a more effective way of aligning thinking and practice and accelerating the flow of promising practices across the supply network. Secondly, address the challenge of ever increasing complexity.

The stages of SCI presented here represent what we think to be the next stages in the evolution of SCI. Goal directed supply networks evolved from external integration when firms realized that they existed within a network and non-strategic suppliers could benefit from the sharing of demand data to facilitate planning. The next stage of evolution was devolved, collaborative clusters. Clusters arose as focal firms realized that the coordination of a network was burdensome and that lead suppliers could manage clusters to reduce these coordination costs. This brings us to the current state-of-the-art but what could the next 25 years have in store for SCM?

Changes to supply chains over the next quarter of a decade will be driven by changes in the business environment, technology, economies, and customer preferences. There is no doubt that the business environment will become even more volatile, uncertain, complex, and ambiguous (cf. Bennett and Lemoine, 2014). As such, supply chains need to be configured to navigate the future environment and will move ever closer to becoming complex adaptive systems (cf. Choi et al., 2001). We are also seeing a rise in technologies that have promise for tomorrow's supply chains and the democratization of product and process knowledge (Anderson, 2012). These include big data and additive manufacturing technologies such as 3D printing (Brennan et al., 2015). Overlaid upon this are changes within developing economies as they industrialize and wages in those countries increase. As countries move from developing to developed, they become less attractive as manufacturing destinations as the cost benefits are eroded. A reduction in cost benefits, coupled to higher logistics costs, long transport times, and increased risks have influenced firms to move production closer to the point of consumption (Ellram et al., 2013); a phenomena

known as re-shoring or near-shoring. A further complicating factor is that customers will require even more differentiation and we will move towards 'markets of one'. We are already seeing this on a limited scale with the customization of sportswear through the MI-Adidas and Nike-ID initiatives but these provide somewhat limited choices. We suggest that customers will require greater levels of customization. Given these changes, what will the supply chain of the future look like?

We suggest that the SCOM of the future will be transient, atomized, adaptive fulfillment networks. They will be transient because they will form to fulfill a specific but limited demand that will require a combinatorial blend of supplier capabilities for a limited market. They will be atomized – rather than clustered – because information technology, shared thinking and a common supply chain language will allow the identification of, and communication with, suppliers identified anywhere globally. They will be adaptive to both supply and demand as well as being reactive and proactive to wider geo-political, business, economic, environmental and social factors. The networks of the future will also be democratic to supply and demand, hence our use of the term 'fulfillment'. Integration will be philosophical and driven by behaviors and information, not processes and systems. SCM and SCI have undergone rapid evolution over the past quarter of a century, we look forward to the next 25 years.

**References**

Aitken, J., Christopher, M. and Towill, D. (2002), "Understanding, implementing and exploiting agility and leanness", International Journal of Logistics Management, Vol. 5, No. 1, pp. 59-74.

Anderson, C. (2012), Makers: The New Industrial Revolution. New York: Random House.

Autry, C.W., Rose, W.J. and Bell, J.E. (2014), "Reconsidering the Supply Chain Integration–Performance Relationship: In Search of Theoretical Consistency and Clarity", Journal of Business Logistics, Vol. 35, No. 3, pp. 275-276.

Bagchi, P.K., Chun Ha, B., Skjoett-Larsen, T. and Boege Soerensen, L. (2005), "Supply chain integration: a European survey", The International Journal of Logistics Management, Vol. 16, No. 2, pp. 275-294.

Barney, J. (1991), "Firm resources and sustained competitive advantage", Journal of Management, Vol. 17, No. 1, pp. 99-120.

Bastl, M., Johnson, M. and Choi, T. Y. (2013), "Who's seeking whom? Coalition behavior of a weaker player in buyer–supplier relationships", Journal of Supply Chain Management, Vol. 49, No. 1, pp. 8-28.

Bennett, N. and Lemoine, J. (2014), "What VUCA really means for you", Harvard Business Review, Vol. 92, No. 1/2, p. 27.

Benton, W.C. and Maloni, M. (2005), "The influence of power driven buyer/seller relationships on supply chain satisfaction", Journal of Operations Management, Vol. 23, No. 1, pp. 1-22.

Brennan, L., Ferdows, K., Godsell, J., Golini, R., Keegan, R., Kinkel, S. and Taylor, M. (2015), "Manufacturing in the world: where next?", International Journal of Operations & Production Management, Vol. 35, No. 9, pp. 1253-1274.

Choi, T.Y., Dooley, K.J. and Rungtusanatham, M. (2001), "Supply networks and complex adaptive systems: control versus emergence", Journal of Operations Management, Vol. 19, No. 3, pp. 351-366.

Choi, T.Y. and Hong, Y. (2002), "Unveiling the structure of supply networks: case studies in Honda, Acura, and DaimlerChrysler", Journal of Operations Management, Vol. 20, No. 5, pp. 469-493.

Choi, T.Y. and Wu, Z. (2009a), "Taking the leap from dyads to triads: Buyer–supplier relationships in supply networks", Journal of Purchasing and Supply Management, Vol. 15, No. 4, pp. 263-266.

Choi, T.Y., and Wu, Z. (2009b), "Triads in supply networks: theorizing buyer–supplier–supplier relationships", Journal of Supply Chain Management, Vol. 45, No. 1, pp. 8-25.

Christopher, M. (2000), "The agile supply chain: competing in volatile markets", Industrial Marketing Management, Vol. 29, No. 1, pp. 37-44.

Christopher, M., and Holweg, M. (2011), ""Supply Chain 2.0": managing supply chains in the era of turbulence", International Journal of Physical Distribution and Logistics Management, Vol. 41, No. 1, pp. 63-82.

Christopher, M., and Towill, D. R. (2002), "Developing market specific supply chain strategies", The International Journal of Logistics Management, Vol. 13, No. 1, pp. 1-14.

Disney, S.M. Naim, M. M. and Towill, D. R. (1997), "Dynamic simulation modelling for lean logistics". International Journal of Physical Distribution & Logistics Management, Vol. 27, No. 3/4, pp. 174-196.

Dyer, J.H. and Chu, W. (2000), "The determinants of trust in supplier-automaker relationships in the US, Japan, and Korea", Journal of International Business Studies, Vol. 31, No. 2, pp. 259-285.

Ellinger, A.E., Natarajarathinam, M., Adams, F.G., Gray, J.B., Hofman, D. and O'Marah, K. (2011), "Supply chain management competency and firm financial success", Journal of Business Logistics, Vol. 32, No. 3, pp. 214-226.

Ellinger, A., Shin, H., Magnus Northington, W., Adams, F.G., Hofman, D. and O'Marah, K. (2012), "The influence of supply chain management competency on customer satisfaction and shareholder value", Supply Chain Management: An International Journal, Vol. 17, No. 3, pp. 249-262.

Ellram, L.M., and Liu, B. (2002), "The Financial Impact of Supply Management", Supply Chain Management Review, Vol. 6, No. 6,pp. 30-37.

Ellram, L.M., Tate, W. L. and Petersen, K.J. (2013), "Offshoring and reshoring: an update on the manufacturing location decision:, Journal of Supply Chain Management, Vol. 49, No. 2, pp. 14-22.

Fabbe-Costes, N. and Jahre, M. (2008), "Supply chain integration and performance: a review of the evidence", The International Journal of Logistics Management, Vol. 19, No. 2, pp. 130-154.

Flynn, B.B., Huo, B., and Zhao, X. (2010), "The impact of supply chain integration on performance: a contingency and configuration approach", Journal of Operations Management, Vol. 28, No. 1, pp. 58-71.

Forrester, J.W. (1958), "Industrial dynamics: a major breakthrough for decision makers", Harvard Business Review, Vol. 36, No. 4, pp. 37-66.

Fredriksson, A. and Jonsson, P. (2009), "Assessing consequences of low-cost sourcing in China", International Journal of Physical Distribution and Logistics Management, Vol. 39, No. 3, pp. 227-249.

Frohlich, M.T. and Westbrook, R. (2001), "Arcs of integration: an international study of supply chain strategies", Journal of Operations Management, Vol. 19, No. 2, pp. 185-200.

Gereffi, G. (1999), "International trade and industrial upgrading in the apparel commodity chain", Journal of International Economics, Vol. 48, No. 1, pp. 37-70.

Gersick, C.J. (1991), "Revolutionary change theories: A multilevel exploration of the punctuated equilibrium paradigm", Academy of Management Review, Vol. 16, No. 1, pp. 10-36.

Ghemawat, P. (2005), "Regional strategies for global leadership", Harvard Business Review, Vol. 83, No. 12, pp. 98-108.

Gunasekaran, A., and Ngai, E.W. (2004), "Information systems in supply chain integration and management", European Journal of Operational Research, Vol. 159, No. 2, pp. 269-295.

Hamel, G. and Prahalad, C.K. (1990), "The core competence of the corporation", Harvard Business Review, Vol. 68, No. 3, pp. 79-91.

Hammer, M. (1990), "Reengineering work: don't automate, obliterate", Harvard Business Review, Vol. 68, No. 4, pp. 104-112.

Harland, C.M. (1996), "Supply chain management: relationships, chains and networks", British Journal of Management, Vol. 7, No. S1, pp. S63-S80.

Hawkins, D.E. (2013). Raising the Standard for Collaboration: Harnessing the Benefits of BS 11000, Collaborative Business Relationships. London: BSI.

Hayes, R.H. and Wheelwright, S.C. (1984), Restoring our competitive edge: competing through manufacturing. Boston: HBS Press.

Hines, P., and Rich, N. (1997), "The seven value stream mapping tools", International Journal of Operations and Production Management, Vol. 17, No. 1, pp. 46-64.

Horvath, L. (2001), "Collaboration: the key to value creation in supply chain management", Supply Chain Management: An International Journal, Vol. 6, No. 5, pp. 205-207.

Johnson, M. and Mena, C. (2008), "Supply chain management for servitised products: a multi-industry case study", International Journal of Production Economics, Vol. 114, No. 1, pp. 27-39.

Johnson, M. and Templar, S. (2011), "The relationships between supply chain and Firm performance: The development and testing of a unified proxy", International Journal of Physical Distribution and Logistics Management, Vol. 41, No. 2, pp. 88-103.

Lambert, D.M. and Burduroglu, R. (2000), "Measuring and selling the value of logistics", The International Journal of Logistics Management, Vol. 11, No. 1, pp. 1-18.

Lapide, L. (2010), "A history of CPFR", The Journal of Business Forecasting, Vol. 29, No. 4, pp. 29-31.

Lee, H.L. (2002), "Aligning supply chain strategies with product uncertainties", California Management Review, Vol. 44, No. 3, pp. 105-119.

Lee, H.L., Padmanabhan, V. and Whang, S. (1997), "Information Distortion in a Supply Chain: The Bullwhip Effect", Management Science, Vol. 43, No. 4, pp. 546-558.

Lee, H.L., So, K.C. and Tang, C.S. (2000), "The value of information sharing in a two-level supply chain", Management Science, Vol. 46, No. 5, pp. 626-643.

McFarlane, D. and Sheffi, Y. (2003), "The impact of automatic identification on supply chain operations", The International Journal of Logistics Management, Vol. 14, No. 1, pp. 1-17.

McGaughey, S.L. (2002), "Strategic interventions in intellectual asset flows", Academy of Management Review, Vol. 27, No. 2, pp. 248-274.

Mentzer, J.T., Stank, T.P. and Esper, T.L. (2008), "Supply chain management and its relationship to logistics, marketing, production, and operations management", Journal of Business Logistics, Vol. 29, No. 1, pp. 31-46.

Miles, R.E. and Snow, C.C. (2007), "Organization theory and supply chain management: An evolving research perspective", Journal of Operations Management, Vol. 25, No. 2, pp. 459-463.

Montgomery, D.C. and Woodall, W.H. (2008), "An overview of six sigma", International Statistical Review, Vol. 76, No. 3, pp. 329-346.

Naylor, J.B., Naim, M.M. and Berry, D. (1999), "Leagility: integrating the lean and agile manufacturing paradigms in the total supply chain", International Journal of Production Economics, Vol. 62, No. 1, pp. 107-118.

Oliver, R.K. and Webber, M.D. (1982), "Supply-chain management: logistics catches up with strategy", Outlook, Vol. 5, No. 1, pp. 42-47.

O'Marah, K., & Hofman, D. (2010). The AMR supply chain Top 25 for 2010. *Gartner Research*.

Orlicky, J. (1975). MRP: Material Requirements Planning: The New Way of Life in Production and Inventory Management. McGraw Hill: New York.

Pagell, M. (2004), "Understanding the factors that enable and inhibit the integration of operations, purchasing and logistics", Journal of Operations Management, Vol. 22, No. 5, pp. 459-487.

Pagell, M. and Wu, Z. (2009), "Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars", Journal of Supply Chain Management, Vol. 45, No. 2, pp. 37-56.

Pinch, S., Henry, N., Jenkins, M. and Tallman, S. (2003), "From 'industrial districts' to 'knowledge clusters': a model of knowledge dissemination and competitive advantage in industrial agglomerations", Journal of Economic Geography, Vol. 3, No. 4, pp. 373-388.

Porter, M.E. (1998), "Clusters and the new economics of competition", Harvard Business Review, Vol. 76, No. 6, pp. 77-90.

Porter, M.E. (2008). Competitive Advantage: Creating and sustaining superior performance. New York: Simon and Schuster.

Prajogo, D. and Olhager, J. (2012), "Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration", International Journal of Production Economics, Vol. 135, No. 1, pp. 514-522.

Schmenner, R.W. and Swink, M.L. (1998), "On theory in operations management", Journal of Operations Management, Vol. 17, No. 1, pp. 97-113.

Sheffi, Y. (2012), Logistics clusters: Delivering value and driving growth. Boston: MIT Press.

Srivastava, S.K. (2007), "Green supply ‐ chain management: a state-of-the-art literature review", International Journal of Management Reviews, Vol. 9, No. 1, pp. 53-80.

Stevens, G.C. (1989), "Integrating the supply chain", International Journal of Physical Distribution and Materials Management, Vol. 19, No. 8, pp. 3-8.

Storey, J., Emberson, C., Godsell, J. and Harrison, A. (2006), "Supply chain management: theory, practice and future challenges", International Journal of Operations and Production Management, Vol. 26, No. 7, pp. 754-774.

Swink, M., Narasimhan, R. and Wang, C. (2007), "Managing beyond the factory walls: effects of four types of strategic integration on manufacturing plant performance", Journal of Operations Management, Vol. 25, No. 1, pp. 148-164.

Tallman, S., Jenkins, M., Henry, N. and Pinch, S. (2004), "Knowledge, clusters, and competitive advantage", Academy of Management Review, Vol. 29, No. 2, pp. 258-271.

Tan, K.C. Kannan, V.R. and Handfield, R.B. (1998), "Supply chain management: supplier performance and firm performance", Journal of Supply Chain Management, Vol. 34, No. 3, pp. 2-9.

Trent, R.J. (2004), "What everyone needs to know about SCM", Supply Chain Management Review, Vol. 8 No. 2, pp. 52-9.

van Hoek, R.I. (2001), "The rediscovery of postponement a literature review and

directions for research", Journal of Operations Management, Vol. 19, No. 2, pp. 161-184.

Wight, O. (1981), MRP II: Unlocking America's Productivity Potential. CBI Publishing: Boston.

Womack, J.P., Jones, D.T. and Roos, D. (1990), The Machine that Changed the World. New York: Simon and Schuster.